

Technological Strategies Implemented by Livestock Farmers Specialized in Goat Breeding in the Mountain Region of San Juan, Mendoza and La Rioja Provinces in Argentina

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Abstract

The goat farming is of great relevance in the mountain ranges of San Juan, La Rioja and Mendoza Provinces in Argentina. Out of the three, Mendoza province has the highest number of goats in the country. This system of production is majorly managed by the family members making it an integral part of the Family Farming sector. This type of production generates work in a pauperized sector and at such places that are distant from the urban centres where possibility of alternative occupations is scarce or almost nil. The animal rearing activity focuses on primary production with little value addition, high seasonality, and informal and rudimentary marketing strategies. These activities primarily employ tacit knowledge acquired over the years by trial-and-error method. Transhumance, as a strategy for the use of the natural environment, reveals the existence of a thorough knowledge of the seasonal productivity of the grasslands of the mountain valleys. Research and extension organizations develop projects aimed at improving these production systems through the implementation of contemporary technologies. The objective of this paper is to identify the technological strategies implemented by the Family Farming sector specialized in goat breeding in the mountain region of the provinces of Mendoza, San Juan and La Rioja, with specific focus on their origin, specific problems they face, and strategic similarities and differences to propose recommendations for the research and extension organizations.

Keywords

Family farming; Pastoralism; Goat production; Rural extension

1. Introduction

Goat farming is of great relevance in the mountain area of the provinces of the Cuyo region in the western part of Argentina.

According to SENASA¹ data, collected in 2020, Mendoza with 742,413 heads, has the second highest number of goats in the country, after Neuquén (SENASA, 2020). In accordance with the Article 5 of Law No. 27,118 of Argentina, a family farmer is defined as the one who carries out agricultural, livestock, forestry, fishing and aquaculture activities in rural areas and meets the following requirements: a) management of the productive enterprise is exercised directly by the producer and/or a member of their family; b) Owns all or part of the means of production; c) Work requirements are covered mainly by family labour and/or supplementary contributions from employees (Ministerio de Justicia y Derechos Humanos, Presidencia de la Nación Argentina, 2015). Javier Balsa proposes that a central defining feature of family farming is that the family forms a work team (Balsa, 2012).

The principal contribution to goat pastoralist production is provided by the families involved, so it is limited, almost exclusively, to the family farming (FF) sector. This type of production generates work for the population that is characterized by low income, informality and located at places distant from urban centers, where there are very scarce or no alternative occupations, so the opportunity cost is very low or zero.

Goat feeding is based on wild grassland species, including rotational grazing in some cases, as is the practice of transhumance and punctual supplementation when the forage supply does not cover the animal's dietary needs. Goat husbandry in this region is the means of primary production because of high seasonality and informal and rudimentary marketing strategies. The distance to the urban centers where production is marketed, and the high freight costs involved both in the sale of products and in the supply of inputs, limit the potential competitiveness within this production system. The production activities are dictated by ancestral traditions that use tacit knowledge acquired over generations by trial-and-error method and constitute symbolic capital for the people of the region. Transhumance, as a strategy for the use of the natural environment, reveals the existence of a practical and meticulous knowledge base to manage the seasonal productivity of the grasslands in the mountainous valleys.

Development projects implemented by research and extension organizations are, and historically have been, aiming at improving these production systems by implementing thoroughly researched and experimented technologies. It leads to a confrontation between different approaches to knowledge acquisition that on many occasions create unexpected misunderstandings. Therefore, the main objective of the present work is to clearly identify and understand the technological strategies implemented by the livestock farmers specialized in goat breeding in the mountain regions of San Juan, Mendoza and La Rioja Province.

2. Methodology

This work adheres to a descriptive exploratory framework. We begin by analysing secondary data presented in six projects in the program portfolio of the National Institute of Agricultural Technology of Argentina (INTA), that address goat production in the mountain regions of the provinces of Mendoza, San Juan and La Rioja. This preliminary analysis allowed us to identify the analytical categories that were subsequently investigated in in-depth interviews with 26 family producers. These interviews were conducted to understand the technologies applied in different situations. The work was therefore carried out in two stages: first, a literature review and second, personal in-depth interviews.

The authors interviewed four producers in the department of San Rafael and two in the department of Malargüe, both in the province of Mendoza; six producers in the

¹ National Service of Food Health and Quality of Argentina

department of Jáchal and six in the department of Iglesia, both located in the province of San Juan; four producers in the department of Felipe Varela, two in the department of Villa Castelli and two in the department of Vinchina in the province of La Rioja.

The proposals analyzed for this study were those implemented as extension intervention strategies by the Instituto Nacional de Tecnología Agropecuaria (INTA) units present in the area. The project "Strengthening the Production of Small Ruminants in the Andean Valleys of San Juan and Mendoza" (Instituto Nacional de Tecnología Agropecuaria (INTA) Centro Regional Mendoza - San Juan, 2020) of the INTA², as part of the program portfolio of the Cuyo region and projects previously developed by the Federal Program for Sustainable Rural Development (PROFEDER) of INTA at a national level including the following:

- "Integrated Territorial Development, Malargüe, Mendoza" (Instituto Nacional de Tecnología Agropecuaria (INTA) AER Malargüe, 2004).
- "Regional Development Project through the Use of Special Fibers" (Instituto Nacional de Tecnología Agropecuaria (INTA) AER Malargüe, Mendoza).
- "Integrated Territorial Development, Carrizalito, Agua Botada, La Salinilla, Agua Nueva" (Instituto Nacional de Tecnología Agropecuaria (INTA) AER Malargüe, Mendoza).
- "Promotion of Value-Added to Local and Tourism Production of the Bermejo Valley Region, La Rioja province" (Instituto Nacional de Tecnología Agropecuaria (INTA) AER Valle del Bermejo).
- "Support for the Socio-Productive Development of the Bermejo Valley" (Instituto Nacional de Tecnología Agropecuaria (INTA), AER Valle del Bermejo).

The distribution of interviews by department and province was determined based on accessibility of the producers by the local extension professionals. A set of questions (Table 1) was created as a guide based on our professional experience and the categories of topics extracted from the analyzed projects.

Table 1: Questions asked from the respondents

<i>Category</i>	<i>Thematic area</i>	<i>Guiding Questions</i>
Management	Food, nutrition	How is the grazing managed? What plant species are consumed by animals? What is the carrying capacity? Is rotation of grazing areas practiced? Is supplementation done at any time of the year? To what category of animals? Are there times of lack of pasture, when do they occur and what strategies are implemented for them?
	Facilities	What is the design of the corrals, what materials are used? Why are they made in a certain way? What facilities are present? What is the origin of the model used? How old are the facilities? Who made them?
	Health	What are the health problems present? What practices are carried out to address them? How often? Is the producer in charge of the sanitary practices or does someone from outside the establishment?
	Logistics	Is transhumance practiced? How are animals managed during winter and summer? How are the animals moved, with herder on a horse, by truck? Do they have

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<i>Category</i>	<i>Thematic area</i>	<i>Guiding Questions</i>
		vans? How far do the animals have to move? How many days does the transfer take? How do they organize the feeding of the people who are in charge during the summer? What activities do they need to do when they arrive at the summer post? How long do they stay at the post? Are the people who are caring for the animals rotated in the summer stall?
Marketing		To whom do they sell the produce? Do they sell all the produce to the same buyer? At what times of the year do they sell? Do they always sell to the same buyer? Is the commercial relationship long standing?
Scale		Are they part of any formal association / organization of producers? Do they work in association with any other producer? For what activities do they associate with others?

3. Results and Discussion

The principal problems identified were organized into three categories depending on the degree of governance exercised by the producing families. According to Fernando Guzmán, we consider those situations of reality as problems with which we do not conform but we have the capabilities that allow us to modify them (Guzmán, 2019). There is agreement in the analysis of the different projects on these problems, which acquire different nuances according to the area.

In this way, the first group of problems that was identified was the 'management' of production systems. It involves decisions related to food, health, genetics, reproduction and facilities. All these aspects are characterized by a high degree of governance exercised by the producing families and, therefore, manifest themselves as an internal scope to the productive system. A second group of problems is related to 'commercial' aspects having poor governance exercised by the producing families manifesting as an area external to the productive system. The third group of problems can be classified as 'scale' having intermediate governance exercised by the producing families. It is manifested in a space external to the scope of decisions of the individual productive system.

3.1 Main Problems identified and described in the Extension Projects

Extension projects address family farming (FF) including the goat production, with varying degrees of specificity. Some, such as those implemented in the department of Malargüe of the province of Mendoza, highlight goat breeding as the central axis, analyze their specific problems, and propose technological strategies for their resolution. Other projects, such as those carried out in the Bermejo Valley of the province of La Rioja, set objectives of integral territorial development among which goat farming is one of the productive activities. These projects do not do in-depth analysis of the restrictions or problems that arise within these production systems, nor do they propose any specific technological strategies that could enhance these production systems.

3.1.1 Management Related Problems

The following 'management' problems are described in the projects:

- a) *Producers have a quantity of animals that exceeds the capacity of forage supply, so there is overgrazing and degradation of natural grassland. Old and unproductive animals are not disposed of in time.*

This analysis is recurrent in all the projects. Reference is made to the impoverishing conditions of the natural pastures. The main cause of this impoverishment is attributed to overgrazing, which the resource has been subjected to over many years due to the maintenance of a number of animals that exceeds the forage supply. This animal overload is linked to the cultural problems of FF where the producers sustain an excess of animals because of the irrationality in their management practices. They consider their social prestige to be associated with the large number of animals reared by them.

As an example, we can cite the project "Integrated Territorial Development, Malargüe, Mendoza" (Instituto Nacional de Tecnología Agropecuaria (INTA) AER Malargüe, 2004), where the following stands out:

"On the other hand, due to the idiosyncrasy of local producers, where the number of animals owned by a producer within a community is a sign of social importance, it is difficult to reduce the number of unproductive goats, to which is added the impact on the natural pasture made by all these animals, with the consequent degradation of the resource."

- b) *Genetics. There is a great heterogeneity of animals due to indiscriminate crossing that causes low quality of the product they offer.*

Though this topic is under scrutiny and remains controversial, it persists as a prominent problem discussed in all the projects. It is notable that in most of herds, the Creole breed is predominant with crossbreeding over a time. Breeds such as the Anglo Nubian, Boer, Saanen and others, have been introduced when the economy of the producers permits and through programs that have encouraged the incorporation of other breeds.

In the project "Integrated Territorial Development, Carrizalito, Agua Botada, La Salinilla, Agua Nueva" (Instituto Nacional de Tecnología Agropecuaria (INTA) AER Malargüe, Mendoza) it is stated that:

"The predominant goat breed is Creole, which is characterized by great rusticity and adaptation to the local environment, and in smaller numbers crosses with Anglo Nubian and Angora. There is not a single type of animal as a consequence of indiscriminate crossings, which determines a great heterogeneity and low quality of the product offered."

It is important to note that these additions have generally not followed an orderly plan of genetic improvement or considered adaptation to the natural environment. In cases where crosses introduced larger breeds to the Creole, for example, the Anglo Nubian or Boer, the animals had greater weaning weights, but also greater food demand.

- c) *Not locking the animals in the pen daily nor handling them by a shepherd*

This problem has been highlighted in the southern area of Mendoza, where it is common for producers not to lock up the animals every afternoon, so they remain in

the pasture for 2-3 days without supervision, thus exposing them to risks. Permanent accompaniment by a shepherd is not a common practice anywhere in the region and there is a growing loss of animals due to predators.

d) Low proportion of males used in service

It is common to find a lower percentage of males than recommended, noting that they do not exceed 3% in most establishments. In the project "Integrated Territorial Development, Carrizalito, Agua Botada, La Salinilla, Agua Nueva" (Instituto Nacional de Tecnología Agropecuaria (INTA) AER Malargüe, Mendoza), this problem is described as:

"The proportion of males used in the service is very low and the presence of old females that produce weak kids consuming low milk production means that the productivity indices are low."

e) There are a few health controls

It is noted that in most cases health controls are not conducted beyond traditional treatments. These are not based on a diagnosis by a qualified professional but on the tacit knowledge of the producers. It may also include some inappropriate practices having poor impact on the health of the animals.

3.1.2 Commercial Problems

The 'commercial' problems highlighted in the projects include:

a) Atomized sale of production directly on the spot

This is the traditional way of selling through which most of the produce is marketed. However, in production systems that are close to cities or on important communication routes, a large proportion of produce is sold for slaughtering directly to the consumers for higher prices. This is done, however, without complying with current sanitary standard legislation.

The problems linked with the competitiveness of the production systems clearly stand out in the project "Support for the Socio-Productive Development of the Bermejo Valley" (Instituto Nacional de Tecnología Agropecuaria (INTA), AER Valle del Bermejo).

"High percentage of informal marketing, with productive areas isolated from the commercial circuit, do not present marketing strategies and hence lack quality controls."

b) Low profitability caused by low prices obtained from production, which causes decapitalization of producers.

It is highlighted in most of the projects that the prices paid by the intermediaries, which are the merchants buying the majority of the production, are low or insufficient. This situation erodes the capacity for maintenance and growth of the productive systems. In the project "Integrated Territorial Development, Carrizalito, Agua Botada, La Salinilla, Agua Nueva" (Instituto Nacional de Tecnología Agropecuaria (INTA) AER Malargüe, Mendoza), the following stands out:

"The situation raised together with other problems leads to a low profitability of the farms due to the low prices obtained and, consequently, to a progressive decapitalization of the sector, which motivates social phenomena such as the rural exodus and school failure."

c) There are no agro-industries allowing the production of products with added value at origin

Frequently highlighted is the lack of strategies to add value to the production at a local level, so that farmers get more revenue on the final product. Further analysis indicates that there is little or no presence of agro-industries in the areas of production, which can add value to the products, and that there is poor processing of by-products and handicrafts.

d) Scarcity of commercial alternatives

This problem is related to the previous one and focuses on the need for diversification of production in the face of the limitation of income due to the sale of a primary product. However, there may be many other ways to generate income by adding value to the production at origin.

3.1.3 Scale Related Problems

A third group of issues is related to 'scale', which means that only a few organizations and producers are working in a coordinated way. These problems are frequently mentioned in the description of the situation analysis of the projects. Cooperative and coordinated work is considered to improve the economic results of the productive system. This is possible through lower purchase prices (of inputs), higher product prices, and joint sale to the distributors avoiding wholesale intermediation.

In some cases, the producers' association notices gender issues, highlighting the lack of women's associations. In the project "Integrated Territorial Development, Carrizalito, Agua Botada, La Salinilla, Agua Nueva" (Instituto Nacional de Tecnología Agropecuaria (INTA) AER Malargüe, Mendoza), it is underscored that women play an important role in production activity as they perform fundamental tasks during the calving season. Women are also in charge of the animals that remain in the lowlands during the summer season in areas where transhumance is practiced and the men go up the Andes mountain range with rodeos. There is no organization of rural women allowing for social leadership in this sector of goat rearing.

There is also frequent mention in the projects of the scarce use of appropriate technologies, without going into further detail regarding what technologies and the evidence are missing.

3.2 Summary of the Principal Technological Strategies Applied and Identified

Considering the breadth of the area considered for analysis, a variety of technological practices are employed in accordance with the natural characteristics of the environment, the customs of family producers, and the requirements of the destination markets.

The technological practices are organized in accordance with the thematic divisions of the interviews, and are described as under:

a) Feeding

Grazing, in most cases, happens in the open fields with notable differences between different fields under study. In the southern Mendoza, transhumance is the norm with shepherds moving the animals every December. In many cases, they cover the distances as far as 100 km or more to reach the outposts in the mountain range where they remain until the end of May before the snowfall begins. These transfers of animals take an average of approximately 7 days.

According to a producer, who visited the department of San Rafael in the province of Mendoza, he moves the animals every year in December covering a journey of 105 km that lasts 7 days until the source of the Atuel river in the Andes Mountains. There they graze in natural pastures until the end of May when they return to the lowlands taking a 5-day journey. The outposts in the mountain range are usually leased fields as part of a long-standing business relationship, in many cases more than 20 years old, although the contracts are annual. The remainder of the year the animals are pastured in fields in lower areas that are usually owned by the family producers. In most cases, they do not have legal deeds to these pastures, which is a problem manifested on a recurring basis.

This way, the productivity of the pasture is rotated through different areas and times of the year. The respondents highlighted the decrease in forage supply in recent years in which rainfall has decreased considerably and water sources, which were previously abundant, have dried up. To address this, in some cases, animals are supplemented during the winter months with corn or bales bought from a nearby agricultural area under irrigation. For example, a producer that we visited in the Iglesia department of the province of San Juan buys lucerne (*Medicago sativa* L.) bales from farmers who produce in the area having irrigation.

In the Andean departments of San Juan, some producers practice transhumance with moving the animals to outpost in the Andes, spending the summer months in the mountain range, while others keep animals in the low fields all year round. It is very common for the same producer to have irrigated lots in the low areas where they grow lucerne (*Medicago sativa* L.), which is preserved "encastillada" (stacked in the field), and corn is used to supplement during the months of scarcity usually at the end of winter. In the Bermejo Valley of La Rioja, where transhumance is less practiced, the animals remain all year-round on the same property and usually do not receive supplementation.

When analyzing the restrictions of the forage supply over the years, producers relate the scarcity of forage with the dry years, and the abundance with periods of greater rainfall without considering the importance of the stocking of forage. This is due to the fact that it is hard to track because of the difficulty involved in analyzing it in open farms and with movements of animals between different fields during winters and summers. To compound this, none of the producers graze only goats and their rodeos are usually composed of cows, goats, sheep and horses, which make a differential use of the forage supply.

b) Facilities

The facilities are constructed of materials available in the area such as sticks, straw, and stone. Although it is also very common to find constructions made from pallets and wire in the areas closer to cities. The use of enclosures dates back many years. They are used to enclose and shelter the animals with coverings on the southern side having roofed space to protect animals from the rain. In the mountainous area of San Juan, the main protection necessary for animals is on the west side since the prevalence of the Zonda wind³ is high.

It is common that the facilities are not properly maintained. It contains a marked accumulation of manure that previously was sold as a fertilizer to farmers owning vineyards in the provinces of San Juan and Mendoza. In recent years, this practice has decreased due to higher freight costs, the infestation of weed seeds, and replacement by chemical fertilizers.

³ Strong, hot and dry wind that comes from the west. This wind phenomenon originates in the Pacific Ocean where it is initially full of humidity. As it crosses the Andes mountains, it discharges snow on the peaks, and moves down the mountains into Argentina mainland, while increasing temperatures and decreasing humidity as it descends.

The practice of locking up animals varies according to the area. In the southern Mendoza, once the number of animals is controlled with no registered health problems, it is very common that animals are not confined every day but only every three or more days. In the province of La Rioja, however, the animals are released every morning to graze and in the afternoon they return back to where they are locked up until the next day. Very few pens have water troughs as the animals typically drink from streams or watercourses available in the field.

c) Health

Sanitary practices are very basic, usually managed by the producers themselves and based on knowledge acquired informally and transmitted generationally. The presence of "corrocho" (*Fasciola hepatica*) is common, and it affects the animals mainly during "la veranda" when their principal water source are the natural mountain streams. In the southern part of Mendoza, the producers mention that the animals suffer from diarrhea when they return to the lowlands from the outpost in the Andes mountains and consume the water from the lower fields. In many cases, these water sources have an origin in shallow perforations and undergo process of increased salinization during periods of drought. While the water is suitable for animal consumption, it is of a lower quality than what they have available in the outposts of the mountain range.

The presence of "mascadera"⁴ is frequently mentioned, due to the consumption of the fruits of "Algarroba" (*Prosopis alpataco*). In the province of San Juan, the poisoning of animals through the consumption of toxic plants is recorded. However, the respondents were not able to identify the toxic plants and what kind of poisoning they cause. The mastitis and abortions are also common, yet not exceeding 10% of the herd.

d) Logistics

Different animal management practices are employed in the different locations of this study. As highlighted above, transhumance is common in the southern part of Mendoza, taking advantage of the high-altitude pastures during the months of December till the first days of May. This involves the movement of animals over considerable distances and is done with shepherds on horseback or in some cases, with trucks. This practice is common in all three areas under study, however, its frequency decreases going from south to north i.e., being very common in Malargüe and very rare in La Rioja.

Agreements are usually made between producers to move the animals together each taking his turn during the stay of animals in the outposts up in the Andes mountains. It is the men who travel up to the mountains, stay approximately 15 days in the outpost from where they return to the lower fields. While the mountain outposts have precarious constructions, it is necessary that while herding the men carry with them all the necessary utensils in addition to food stuff, which is then supplemented with frequent slaughters practiced during the season. In the southern zone mating is concentrated from May to June. The bulk of the births occur in the months of October to November. This allows the producers to take advantage of greatest demand for kids at the end of the year.

The "Castrones" (males) are kept separate from the females from October to April, a period in which it is common for them to be in the care of "Castroneros" who charge for the service approximately equal to the value of a kid. In San Juan and La Rioja, mating is continuous; the males are kept together with the females throughout the year, and thus births also occur year-round. In some instances, as in San Juan, this can

⁴ "Mascadera" is a chronic emaciating neuropathy affecting goats.

cause inconveniences with high kid mortality due to births in the cold season, when there is a lack of fodder and mothers are in poor body condition. While in the Bermejo Valley in the province of La Rioja, kid births taking place all year round is a productive strategy, as the forage supply is greater. There is also a growing year-round tourism due to the proximity of two national parks and they can sell directly to restaurants and hotels, achieving substantially higher prices than selling through intermediaries.

An issue that is present in all the producing areas is mortality by predators. The most common are pumas and condors. In production near the inhabited areas, the presence of dogs can also cause serious damage to the herds.

4. Conclusion

A variety of situations were documented in the project areas across the mountains of the Cuyo. The technological practices implemented by the goat producers in the region have influence over the situations. On the one hand, a joint construction with the producers was recorded in long-standing projects such as those carried out in the Malargüe department in the province of Mendoza and those in the Bermejo Valley in the province of La Rioja. On the other hand, in areas where animal husbandry projects have not been carried out, as in the western departments of San Juan province, production is aligned to a greater extent with traditional productive practices.

Considering that extension projects were developed after identifying problems using participatory methodologies where the producers were consulted, there is a logical relationship between the activities proposed and the current problems. A notable inconsistency, where the relationship is not clear, is related to the overgrazing and degradation of natural grassland as highlighted in the projects. Additionally, the animal overload is linked to the cultural factors of the family producers. Having more animals is considered prestigious from socio-cultural perspectives. This is not an isolated observation confined to this productive area but is observed across other regions with a pastoral livestock culture and family production patterns.

As observed in this study, these animal management strategies that come into conflict with the forage capacity are more closely linked to the maintenance of capital and the ability to use pasture production in times of greater growth than to hold prestige identification by the producers. However, the frequent animal mortality due to the lack of pasture is evident, and is highlighted in the observations of this study. Along the same lines, Oba (2012: 34) argues that:

“For dryland ecosystems, the effect of biotic factors, such as grazing intensity, on plants has been overemphasized; while the effects of abiotic influences, independent of livestock densities, notably spatial and temporal variability in rainfall, have been ignored.”

The producers relate to a greater extent the restrictions of forage supply with periods of scarce rainfall, without mentioning variations in the number of grazing animals. Another point of merits is the profitability of goat production. Although most of the projects underscore that the low profitability is achieved, yet no demonstrative analysis is presented quantifying the capital at stake. Considering that most producers correspond to the category of family farming, which is characterized by a lack of capital and the presence of a labour force, the profitability analysis would be irrelevant since the capital invested is minimal and has low liquidity, making it difficult to analyze the investment alternatives.

The projects address the goat husbandry with different levels of granularity, but in all cases, the bulk of the proposed activities exceed the scope of the primary system of

goat husbandry incorporating activities aimed at vertical advancement in the production chain, adding value and using by-products, promoting associative forms between producers, both for economic benefits and gender issues, and the incorporation of rural tourism activities. This approach is supported by the intentionality of the programmatic tool. In the case of PROFEDER⁵, the strategy was to move beyond the productive chains approach and towards a systems approach in proposals for rural development, in a context where the resilience strategy is oriented to the reduction of risk levels, rather than the maximization of economic results.

Analysis of the projects demonstrate that while the primary activity of goat husbandry yields an acceptable productive performance, the activity by itself is not enough to satisfy family necessities or the aspirations of family members. Therefore, the focus is on increasing income through aggregate activities. According to Ian Scoones, a central characteristic of the way in which pastoralist producers respond to uncertainty is by relying on different sources of knowledge (Scoones, 2022). On this basis, we can consider that goat producers capitalize on both their knowledge from the exercise of production through trial and error, the knowledge inherited from generations of goat husbandry, and the knowledge acquired from the technicians in the extension projects. Engagement and openness to varied knowledge sources demonstrates a pragmatic perspective in an environment that imposes difficult working conditions. As a result of this innovative stance, new life strategies are developed reaching beyond the scope of goat or agricultural production without neglecting this basic activity, which provides security in its strategy of social reproduction.

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AUTHORS' DECLARATIONS AND ESSENTIAL ETHICAL COMPLIANCES

Author's Contributions (in accordance with ICMJE criteria for authorship)

<i>Contribution</i>	<i>Author 1</i>	<i>Author 2</i>
Conceived and designed the research or analysis	Yes	No
Collected the data	Yes	Yes
Contributed to data analysis & interpretation	Yes	Yes
Wrote the article/paper	Yes	No
Critical revision of the article/paper	Yes	Yes
Editing of the article/paper	Yes	No
Supervision	Yes	No
Project Administration	Yes	No
Funding Acquisition	No	No
Overall Contribution Proportion (%)	70	30

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Research involving human bodies or organs or tissues (Helsinki Declaration)

The author(s) solemnly declare(s) that this research has not involved any human subject (body or organs) for experimentation. It was not a clinical research. The contexts of human population/participation were only indirectly covered through literature review. Therefore, an Ethical Clearance (from a Committee or Authority) or ethical obligation of Helsinki Declaration does not apply in cases of this study or written work.

Research involving animals (ARRIVE Checklist)

The author(s) solemnly declare(s) that this research has not involved any animal subject (body or organs) for experimentation. The research was not based on laboratory experiment involving any kind animal. Some contexts of animals are also indirectly covered through literature review. In general terms ARRIVE does not correspond to our study because we have been analysing technologies applied by farmers, and their relation with the technological proposals originated from the science and technology sector and their extension programs, and not conducting studies with animals. Therefore, an Ethical Clearance (from a Committee or Authority) or ethical obligation of ARRIVE does not apply in cases of this study or written work. Yet, we are appending the filled-in ARRIVE Checklist just for further clarifications.

Research on Indigenous Peoples and/or Traditional Knowledge

The author(s) solemnly declare(s) that this research has NOT involved Indigenous Peoples as participants or respondents, with the documentation of their Indigenous Knowledge. Some other contexts of Indigenous Peoples or Indigenous Knowledge are indirectly covered through literature review. Therefore, an Ethical Clearance (from a Committee or Authority) or prior informed consent (PIC) of the respondents or Self-Declaration in this regard does not apply in cases of this study or written work.

Research involving Plants

The author(s) solemnly declare(s) that this research has not involved the plants for experiment or field studies. The contexts of plants were only indirectly covered through literature review. Yet, during this research the author(s) obeyed the principles of the Convention on Biological Diversity and the Convention on the Trade in Endangered Species of Wild Fauna and Flora.

(Optional) Research Involving Local Community Participants (Non-Indigenous)

The author(s) solemnly declare(s) that this research has involved local community participants or respondents belonging to non-Indigenous peoples. Yet, this study did not involve any child in any form directly or indirectly. The contexts of different humans, people, populations, men/women/children and ethnic people are also indirectly covered through literature review. Therefore, a sample copy of the prior informed consent (PIC) of the respondents was taken under this study before the face-to-face interviews and interactions.

(Optional) PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses)

The author(s) has/have NOT complied with PRISMA standards. It is not relevant in case of this study or written work.

Competing Interests/Conflict of Interest

Author(s) has/have no competing financial, professional, or personal interests from other parties or in publishing this manuscript. There is no conflict of interest with the publisher or the editorial team or the reviewers.

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To see original copy of these declarations signed by Corresponding/First Author (on behalf of other co-authors too), please download associated zip folder [Ethical Declarations] from the published Abstract page accessible through and linked with the DOI: <https://doi.org/10.33002/pp0104>



The ARRIVE guidelines 2.0: author checklist

The ARRIVE Essential 10

These items are the basic minimum to include in a manuscript. Without this information, readers and reviewers cannot assess the reliability of the findings.

Item	Recommendation		Section/line number, or reason for not reporting
Study design	1	For each experiment, provide brief details of study design including: <ul style="list-style-type: none"> a. The groups being compared, including control groups. If no control group has been used, the rationale should be stated. b. The experimental unit (e.g. a single animal, litter, or cage of animals). 	
Sample size	2	<ul style="list-style-type: none"> a. Specify the exact number of experimental units allocated to each group, and the total number in each experiment. Also indicate the total number of animals used. b. Explain how the sample size was decided. Provide details of any <i>a priori</i> sample size calculation, if done. 	
Inclusion and exclusion criteria	3	<ul style="list-style-type: none"> a. Describe any criteria used for including and excluding animals (or experimental units) during the experiment, and data points during the analysis. Specify if these criteria were established <i>a priori</i>. If no criteria were set, state this explicitly. b. For each experimental group, report any animals, experimental units or data points not included in the analysis and explain why. If there were no exclusions, state so. c. For each analysis, report the exact value of <i>n</i> in each experimental group. 	
Randomisation	4	<ul style="list-style-type: none"> a. State whether randomisation was used to allocate experimental units to control and treatment groups. If done, provide the method used to generate the randomisation sequence. b. Describe the strategy used to minimise potential confounders such as the order of treatments and measurements, or animal/cage location. If confounders were not controlled, state this explicitly. 	
Blinding	5	Describe who was aware of the group allocation at the different stages of the experiment (during the allocation, the conduct of the experiment, the outcome assessment, and the data analysis).	
Outcome measures	6	<ul style="list-style-type: none"> a. Clearly define all outcome measures assessed (e.g. cell death, molecular markers, or behavioural changes). b. For hypothesis-testing studies, specify the primary outcome measure, i.e. the outcome measure that was used to determine the sample size. 	
Statistical methods	7	<ul style="list-style-type: none"> a. Provide details of the statistical methods used for each analysis, including software used. b. Describe any methods used to assess whether the data met the assumptions of the statistical approach, and what was done if the assumptions were not met. 	
Experimental animals	8	<ul style="list-style-type: none"> a. Provide species-appropriate details of the animals used, including species, strain and substrain, sex, age or developmental stage, and, if relevant, weight. b. Provide further relevant information on the provenance of animals, health/immune status, genetic modification status, genotype, and any previous procedures. 	
Experimental procedures	9	For each experimental group, including controls, describe the procedures in enough detail to allow others to replicate them, including: <ul style="list-style-type: none"> a. What was done, how it was done and what was used. b. When and how often. c. Where (including detail of any acclimatisation periods). d. Why (provide rationale for procedures). 	
Results	10	For each experiment conducted, including independent replications, report: <ul style="list-style-type: none"> a. Summary/descriptive statistics for each experimental group, with a measure of variability where applicable (e.g. mean and SD, or median and range). b. If applicable, the effect size with a confidence interval. 	

INFORMATION AND CONSENT FORM FROM RESPONDENTS
(Non-Indigenous or Indigenous Respondents)

This form was translated into local language for the respondents

**Title of the Research: Technological Strategies Implemented by Livestock
Farmers Specialized in Goat Breeding in the Mountain Region of San Juan,
Mendoza and La Rioja Provinces in Argentina**

Principal Researcher: Fernando Diego Guzmán
Area of Research and Technological Development for
Family Farming, CR Mendoza – San Juan, National Institute
of Agricultural Technology of Argentina, Argentina

Research Supervisor: Self

A) INFORMATION TO PARTICIPANTS

1. Objectives of the research

The objectives of this study were to clearly identify and understand the technological strategies implemented by the livestock farmers specialized in goat breeding in the mountain regions of San Juan, Mendoza and La Rioja Province.

2. Participation in research

The researcher will ask you several pertinent questions. This interview will be recorded in written form and should last about 50-60 minutes. The location and timing of the interview will be determined by you, depending on your availability and convenience.

3. Risks and disadvantages

There is no particular risk involved in this project. You may, however, refuse to answer any question at any time or even terminate the interview.

4. Advantages and benefits

You will receive intangible benefits even if you refuse to answer some questions or decide to terminate the interview. You will also contribute to a better understanding of the causes for livelihood transformation of livestock keepers.

5. Confidentiality

Personal information you give us will be kept confidential. No information identifying you in any way will be published. In addition, each participant in the research will be assigned a code and only the researcher will know your identity.

6. Right of withdrawal

Your participation in this project is entirely voluntary and you can at any time withdraw from the research on simple verbal notice and without having to justify your decision, without consequence to you. If you decide to opt out of the research, please contact the researcher at the telephone number or email listed below. At your

request, all information concerning you can also be destroyed. However, after the outbreak of the publishing process, it is impossible to destroy the analyses and results on the data collected.

B) CONSENT

Declaration of the participant

- ⇒ I understand that I can take some time to think before agreeing or not to participate in the research.
- ⇒ I can ask the research team questions and ask for satisfactory answers.
- ⇒ I understand that by participating in this research project, I do not relinquish any of my rights, including my right to terminate the interview at any time.
- ⇒ I have read this information and consent form and agree to participate in the research project.
- ⇒ I agree that the interviews be recorded in written form by the researcher: Yes () No ()

Signature of the participant : _____ Date : _____

Surname : _____ First name : _____

Researcher engagement

I explained to the participant the conditions for participation in the research project. I answered to the best of my knowledge the questions asked and I made sure of the participant's understanding. I, along with the research team, agree to abide by what was agreed to in this information and consent form.

Signature of the researcher :



Date : 02-12-2022

Surname: Guzmán

First name: Fernando

- ⇒ Should you have any questions regarding this study, or to withdraw from the research, please contact Fernando Diego by e-mail guzman.fernando@inta.gob.ar
- ⇒ If you have any concerns about your rights or about the responsibilities of researchers concerning your participation in this project, you can contact the Area of Research and Technological Development for Family Farming, CR Mendoza – San Juan, National Institute of Agricultural Technology of Argentina by email guzman.fernando@inta.gob.ar